

Space Weather Technical Forecast

Issued on Monday, 26 February 2024 at 13:21 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Ongoing likelihood of M-flares with a slight chance of X-flares/S1 Proton Storms throughout and G1/Minor geomagnetic storms day 1 (26 Feb).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate, with the largest flare peaking at M2.0 at 25/1722 UTC from AR3590 in the northwest disc. There are six numbered regions on the disc and one unnumbered region. AR3590 in the northwest remains, by far the largest and most complex region on the disc with little overall change in appearance and complexity. The region is comprised of a large and strong positive polarity leader which shares penumbra with a large negative intermediate spot, leading to a delta configuration. Although this is only a weak delta due to limited magnetic flux along the neutral separation line. There are further small delta spots, including one east of the intermediate spot. The trailer of the spot remains much weaker, and the limited shear across the region limits the flare potential, however given this has produced the strongest flare so far of SC25 (X6.3), with little change to the region, similar sized eruptions still remain possible. The remaining regions on the disc are simpler and much smaller. The as yet unnumbered region in the far northeast appears as a bipolar group, perhaps with north-south magnetic alignment and a moderate amount of magnetic flux.

There were no Earth directed CMEs observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds were observed at background to slightly elevated levels, with ongoing but limited influence from a weak, glancing CME that arrived late on 24 Feb. Speeds varied between 350-430km/s. Density was around average or slightly above. Total Interplanetary Magnetic field (IMF) strength, Bt, started moderate (around 10-13nT) before easing to weak by 26/0900 UTC. The north-south component was largely weak to moderately positive (northward) until around 25/2300 UTC, then mainly weak to moderately negative (southward) until 26/1030 UTC. Phi angle was mainly negative (towards from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 2-3).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux was at background levels. Electron flux (greater than 2MeV) observed at GOES16 has been at normal background levels, with electron fluence well below the Active (1e8 integrated pfu) threshold. The observed 24-hour fluence at 26/0000 UTC was 8.57e5 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to Low, with a likelihood of further M-flares and a slight chance of rising to High with isolated X-flares, primarily from AR3590.

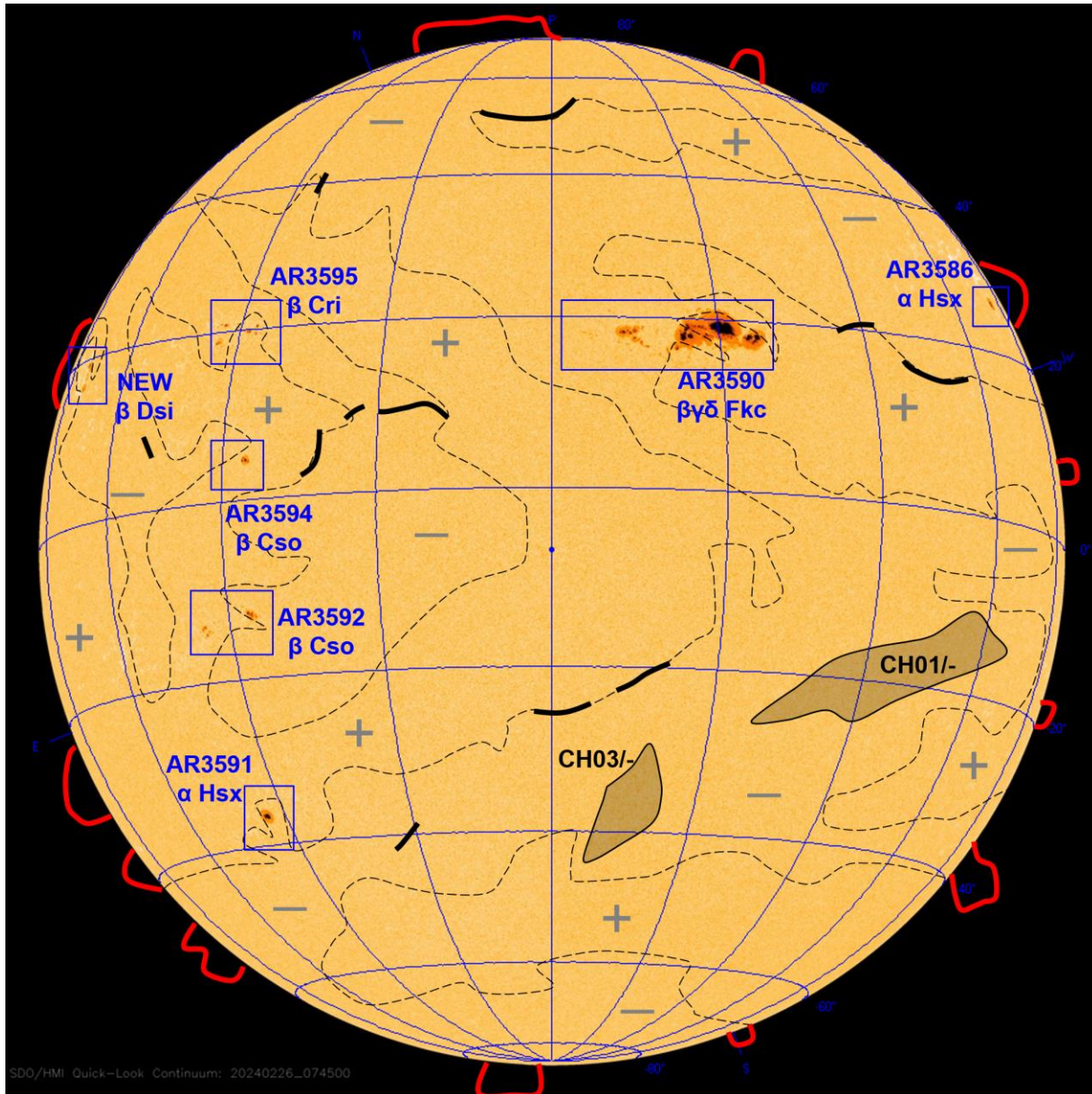
Solar Wind / Geomagnetic Activity: Slightly elevated solar winds may become elevated on day 1 (26 Feb), resulting from the possible onset of the fast wind from CH01/-, before easing day 2 (27 Feb) onwards towards background levels. Quiet to Unsettled geomagnetic activity at first, possible becoming Unsettled to Active with a slight chance of G1 Minor Storms from the coronal hole fast wind onset on day 1 (26 Feb). Quiet to Unsettled activity expected days 2-4 (27-29 Feb).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux

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is expected to remain at background levels, but with a risk of becoming enhanced in the circumstance of any further significant flares from AR3590 in the northwest. This giving a slight chance of exceeding the S1 Minor Radiation Storm level. High energy electron flux (greater than 2MeV) is expected to persist at background at first. An increase to Moderate or High levels is then possible from day 2 (27 Feb) onwards in response to any solar wind enhancement from the coronal hole fast wind onset. 24-hour electron fluence is expected to stay below the Active (1e8 integrated pfu) threshold, but with a rising trend, giving a very slight chance of reaching Active by days 3-4 (28-29 Feb).

Figure 1. Solar Analysis Valid 26/0800 UTC



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

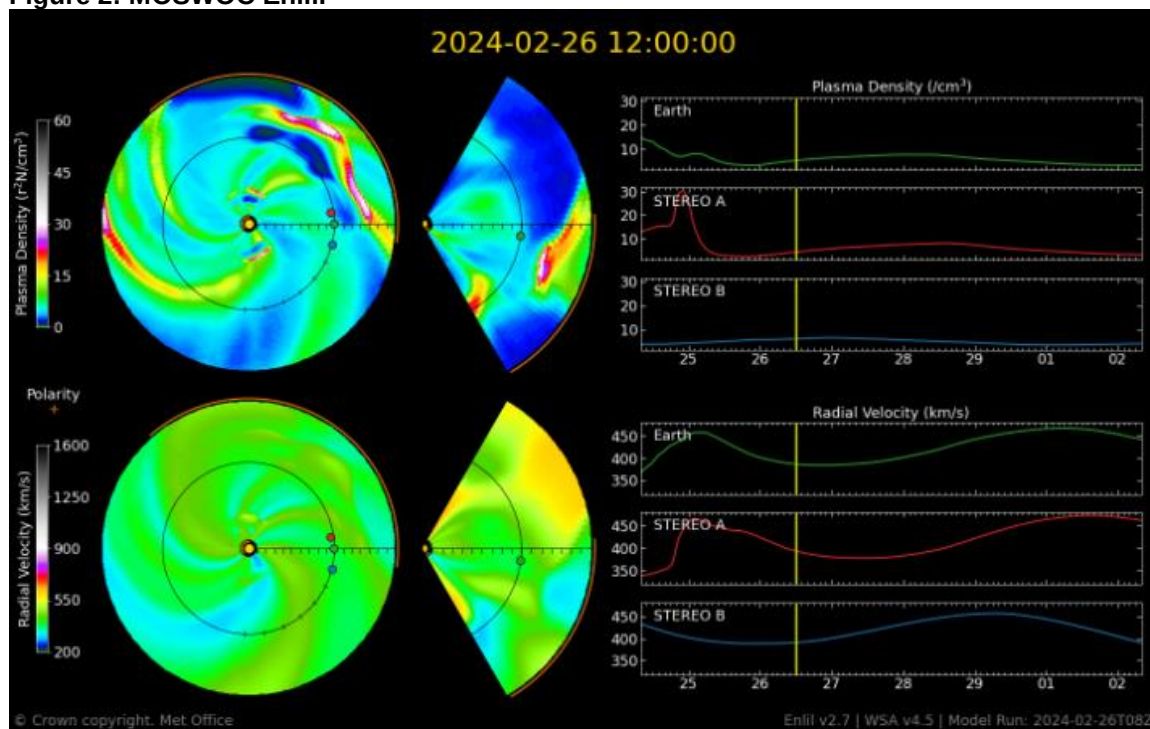
There are no Earth-directed CMEs.

The fast wind of CH01/+ may become geo-effective through the next 24 hours, with solar winds possibly rising to 500-550km/s (elevated). This coronal hole is both negative, which is favourable for geoeffective enhancements at this time of year (Russell-McPherron effect) and a persistent feature, which both support a relatively strong connection. However, the connection of this feature on the previous rotation was subdued, and current MOSWOC enlil modelling suggests the HSS travelling below Earth's orbit, reducing confidence. Any coronal hole enhancement is expected to gradually decline day 2 onward (27 Feb) with solar winds easing to background again by the end of the forecast period, with no further enhancements currently expected.

Geomagnetic activity is expected to be mainly Quiet with isolated Unsettled spells. However the possible onset of fast winds of CH01/-, on day 1 (26 Feb) may bring a spell of Unsettled to Active activity with a slight chance of peak G1 Minor Storm intervals.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	20	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC Enlil.





Radio Blackouts - X-Ray Flares:

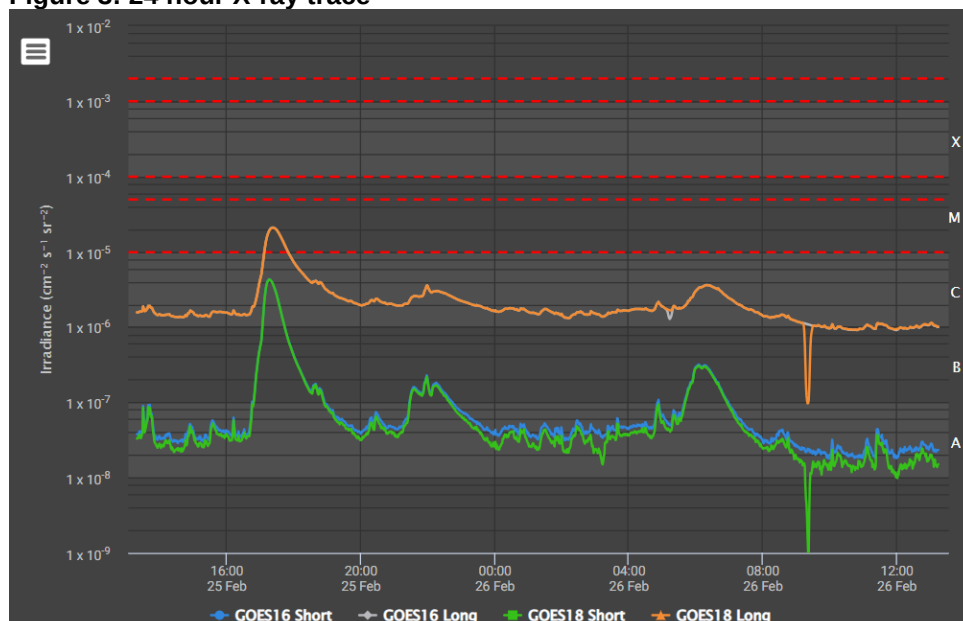
Activity is forecast to be Moderate to Low, with a likelihood of further M-flares and a slight chance of rising to High with isolated X-flares, again primarily from AR3590. The percentage risk of flares is maintained through the period as AR3590 is not expected to completely rotate off the Earth-facing side of the disk until 03 or 04 March.

There are six numbered regions on the disc and one unnumbered region. AR3590 in the northwest remains, by far the largest and most complex region on the disc with little overall change in appearance and complexity. The region is comprised of a large and strong positive polarity leader which shares penumbra with a large negative intermediate spot, leading to a delta configuration. Although this is only a weak delta due to limited magnetic flux along the neutral separation line. There are further small delta spots, including one east of the intermediate spot. The trailer of the spot remains much weaker, and the limited shear across the region limits the flare potential, however given this has produced the strongest flare so far of SC25 (X6.3), with little change to the region, similar sized eruptions still remain possible.

The remaining regions on the disc are simpler and much smaller. The as yet unnumbered region in the far northeast appears as a bipolar group, perhaps with north-south magnetic alignment and a moderate amount of magnetic flux.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	70	70	70	70
Very Active	R3 to R5 X Class	No	20	20	20	20

Figure 3: 24 hour X-ray trace



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Solar Radiation Storms - (High Energy Protons):

GOES18 high energy (greater than 10MeV) proton flux is at normal background levels. However, as AR3590 continues moves across the western disc any further strong flare activity will bring a chance of enhancing the observed proton flux at GEO, especially if those flares are eruptive. This will bring a slight chance of reaching S1 Minor Radiation storm levels, with a very slight chance of stronger storms being observed (S2+).

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	20	20	20	20
Very Active	≥ S3 *	No	5	5	5	5

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm⁻²sr⁻¹s⁻¹)

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) as observed by GOES-16 is currently at background. The possible enhancement from CH01/- may increase populations through the Van Allen Belts, however confidence is low with how strong this enhancement will be. Initially observed at lower orbits, any enhanced flux should relax back to GEO through day 2 and day 3 (27-28 Feb), with the observed GOES-16 flux likely becoming Moderate with a chance of reaching High, primarily at diurnal maximum on day 3 or 4 (28-29 Feb).

The associated 24hr fluence is expected to remain below the Active (1e8 integrated pfu) threshold through much of, if not all of the period, but with a rising trend likely from day 2 (27 Feb). This will give a very slight chance of reaching Active fluence on days 3 and 4 (28 and 29 Feb).

GEO Electron Environment	Level (cm ⁻² sr ⁻¹ day ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1x10 ⁸	No	1	1	5	5
Very Active	≥ 2 MeV ≥ 1x10 ⁹	No	1	1	1	1

Figure 5: MOSWOC REFM integrated Flux/ Fluence forecasts, observations and recurrence.

